Design in Acute Health: Healing Architecture

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Abstract

The purpose of this chapter is to discuss design of acute care settings with a focus on the evolution of design practice over the last decade. In particular, ideas around healing environments describe how design is contributing to enhanced health and wellbeing and how recent developments are helping to create better designs. The chapter covers aspects of the theoretical hypothesis explaining the relationship between people, environment and healing with a focus on three elements: how people perceive the environment, social interaction as part of healing and the influence of people's socio-cultural background. The chapter looks at evidence-informed design in the context of acute healthcare settings whilst also covering trends, challenges and opportunities in healthcare design, and how this field is developing. A case study demonstrates elements of a real project on a before and after basis. The chapter concludes with the message that design of acute care settings involves much more than simply providing a space for care services to take place.

Introduction

In our lives, we dread the day we have to go to an acute care setting. The experience of going into a hospital is unsettling and, in general, we experience growing levels of anxiety, stress and emotional exhaustion. Constant news headlines announcing a steep rise in hospital admissions, a shortage of funds for the rising costs of care delivery for an ageing population and the pressure for a streamlined and more efficient service delivery just does not help with our confidence. The message is one: to do more with less and, altogether, we wonder whether we are not better off staying in our homes.

However, it is not all bad news only. For instance, advancements in technology and treatments support increasingly faster recovery rates. Also, societal changes and a better understanding of patients' and staff demands has led to changes in the way hospitals are designed. Also contributing to that is the development of a better understanding of the relationship between the environments surrounding human beings and health, particularly in healthcare settings. These and other positive changes have led to a new briefing for healthcare facilities, in particular acute care settings that are more focused on people's needs.

It is in relation to this last aspect that this section is elaborated. Here, the thematic unit of architecture is introduced to describe how design has been contributing to enhance health and wellbeing. We understand that architecture attempts to bridge the gap between art and practice, between interesting and meaningful design and that both are important. Thus,

considering both, perhaps with a bias towards a more technical approach to design, we discuss how recent developments are helping the creation of better designs.

To do that, this section discusses evidence-based design and its development into evidence-informed design in the context of acute healthcare settings. It covers trends in healthcare design as well as the challenges and opportunities, and how it is developing. For this purpose, this chapter is divided into three sections covering theory, practice and an example of acute care design solutions. In this way, the chapter should provide valuable information for planners, designers, healthcare providers and the general public interested in this theme whilst also addressing current debate in this area.

The Theoretical Principles Linking the Built Environment Design and Wellbeing

This section on theory discusses the assumption that healing and wellbeing goes far beyond the administration of medication to patients. We discuss here other elements that form part of the healing process and directly or indirectly impact our health and wellbeing, for instance the maintenance of essential human 'functions' such as socialising. The chapter discusses how architecture can support humans engaging in activities, physically and cognitively, individually and/or in groups, introducing the idea of cognitive inclusiveness.

Many theories explain how the design of the built environment affects human life and behaviour. These are important to know as they can influence designers to think differently about their designs. They can give a different sense of purpose for the designs developed. For Sundstrom *et al.* (1996), amongst the theories that have been guiding research, six appear to be more influential in recent research developments around environment and health: Arousal Theory, Environmental Load; Stress and Adaptation; Privacy Regulation; Ecological Psychology and Behaviour Setting Theory; and Transactional Approach. These theories were generated in the Environmental Psychology domain and a short extract of their thesis is presented in the following as adapted from Sundstrom's *et al.*, (1996) work:

***Arousal**: "Psycho-physiological arousal is… a process that mediates influences of environmental features such as sound and temperature. The arousal hypothesis predicts optimum performance and satisfaction under conditions of moderate arousal, depending on task complexity and other factors (Thayer, 1989; Biner et al., 1989). Extensions of the hypothesis suggest that through arousal, high temperature increases the likelihood of violence, though the nature of the relationship remains in debate (Anderson, 1989; Bell, 1992)."*

***Environmental load**: "The overload hypothesis assumes that humans have a finite capacity for processing stimuli and information and predicts that we cope with sensory or information overload through (among other responses) selective attention and ignoring low-priority inputs."* For instance, selective attention in crossing a road is placed on 'distance to cross', 'oncoming vehicles', 'obstacles in the path', whereas low-priority can be 'background scenery' on the other side of the road. Examples of research in this area includes noise and reduced performance in writing (Smith, 1991); masking sound reducing performance deficit due to noise (Loewen and Suedfeld, 1992); reading comprehension of individuals with internal and external locus of control in quiet and noisy conditions (Veitch; 1990). More recently, this approach has been studied in relation to stress (e.g. Hartig *et al*., 2003; Hartig 2007).

Stress and adaptation*: "This theory associates extremes of temperature, sound, and other environmental variables with physiological and psychological stress and with coping and adaptive behaviours that reduce stress or its impact. Environmental stress research examined prolonged exposures (e.g. Hedge, 1989) and post-traumatic outcomes (Rubonis and Bickman, 1991) including chronic illness and psychological impairment. Such findings reinforce the need for theoretical distinction of acute and chronic environmental stress (e.g. Baum et al., 1990; Hobfoll, 1991; and Baum and Fleming 1993)."*

Privacy-regulation*: "Research on privacy, spatial behaviour, crowding, and territoriality together suggests a human tendency to seek optimum social interaction, partly through use of the physical environment (Altman, 1993). Privacy regulation theory suggests that when a person fails to achieve the subjective, optimum level of social contact for the situation, the resulting stress motivates coping behaviour, which may rely on the physical setting (Brown, 1992)."* Examples of research include chair arrangement in a work environment and social interaction (Haggard and Werner, 1990); privacy and higher satisfaction in completing complex tasks (Block and Garnett, 1989).

Ecological psychology and behaviour setting theory*: "This theory analyses environments in terms of behaviour settings: 'small scale social systems composed of people and physical objects configured in such a way as to carry out a routinised program of activities with specifiable time and place boundaries' (Wicker, 1992; Wicker and August, 1995)"*. Research in this area includes the work of McLaren and Hawe (2005) and Sallis *et al*., (2008).

Transactional approach*: "…extension of privacy regulation theory, Altman (1993) and colleagues (Brown et al., 1992 and Werner et al., 1992) elaborated their transactional approach, which treats the physical environment as a potential context for social interaction that can support, constrain, symbolize, and confer meaning upon various aspects of social relationships. This holistic, systems-oriented analysis incorporates multiple levels and facets, variation over time, and cyclical processes. It describes social relationships and physical settings in terms of dialectics, or tensions between opposing influences."* This theory led to the development of the person-environment-occupation theory presented in the work developed by Law *et al*. (1996) and Rebeiro (2001) amongst others.

In addition to the above theories, *Proxemics* is also a theory that connects humans and their behaviour in the built environment. In other words, it refers to peoples' use of their perceptual apparatus in different emotional states during different activities, in different relationships, settings, and contexts (Hall, 1968). Examples of studies include Cook (1970), Raybeck (1991) and McLaughlin *et al*., (2008) who investigated privacy and territorial boundaries.

The field of architecture has also made a theoretical contribution, the *Language of the Space* as proposed by Brian Lawson. Lawson (2001, 2010) states that the built environment has signs and specific characteristics that can be 'read' (as interpreted) by its users. Therefore, it is the language of the space and its 'readability' that influences human behaviour. In general, the behaviour is guided by the users' most important needs first and, basically, it varies from conscious to unconscious behaviours, as well as from controlled to uncontrolled ones.

Despite much progress, as argued by Sundstrom *et al.* (1996) and Gifford (2014), the debate regarding the explanation for how the environment impacts upon a person's health is still wide open and the candidate theories vary considerably. The lack of consensus is not necessarily a bad thing in this context as it gives alternatives for our understanding of this phenomenon and it gives room for necessary trade-offs. Thus the key lesson emerging from the understanding of these theories is that characteristics or different configurations of the

built environment can stimulate positive and negative change in psychological, physiological and physical status.

Other important messages can also be highlighted from these theories. The first is that much attention should be given to individual circumstances. In practical terms, designing for a person in need of urgent care will need to be clear and objective and without distracting elements. Conversely, a person in long term care situation will need those 'distracting' elements that can be used for supporting social interaction. The built environment is perceived through the use of our senses, which stimulate our cognition in the first place and that can trigger a reaction in the second place. Our physical and/or mental status can be positively and negatively stimulated when the 'natural' environmental balance is disturbed; when there is an unclear message embedded in the design of the built environment; and when the design of the built environment imposes barriers preventing individuals from dealing with their priorities. Secondly, the built environment can support or hinder social interaction. In this respect, in a much the inclusion of spaces for social interaction is sought, individual must have, as an alternative, enough space for privacy, reflection and intended seclusion. Finally, the way individuals interpret the environment is also related to their cultural and social background and therefore varies from person to person. As acute care environments are designed to accommodate people with a wide range of backgrounds, to find a design solution that entirely addresses the differences can be impossible.

A Changing Healthcare Sector

Much of the acute care facilities design developed in the last 100 years is directly related to care models in vogue at the time the design was conceptualised. Francis (2004) presents five of the more relevant models that link health and design including the 'custodial', 'medical', 'caring', 'holistic' and 'health promoting' models. Unarguably, these and other care models still directly influence and inform the design of care facilities nowadays.

Another relevant issue that currently impacts on the design of acute care environments is the change in demographics. According to the Office for National Statistics (ONS) 2014, approximately 15 million people in the UK are aged 60 and above and the number of people aged 100 years or above has reached 15.000 (ONS, 2013). As we age, we become more fragile and are prone to develop a range of health related issues simultaneously. Healing takes longer and our capacity to cope in unfamiliar and stressful environments diminishes. As a result, there has been a shift towards design for older people's needs.

These and other issues to a greater and lesser extent impact the design of acute care environments. In addition to those already mentioned, there is a constant change in organisational care targets as such and the redistribution of care services leading to constant refurbishments and reconfiguration of building layout. The increase of the population with different cultural background and the move towards subcontracting services for the delivery of care in environments created for in-house teams also contributes to changes, as does the increase of c-difficile resistance and the tightening-up on infections control measures. These issues generated a series of themed ideas that address key issues for patients and staff including increased patient control, structured private and social areas and increased building flexibility (Lawson, 2004). These themes are interconnected with unclear boundaries and some of the main ideas are presented in the following.

Patient-Centred Design

The idea of developing patient-centred facilities is associated with terms such as 'value for money' which seeks to identify the priorities for the development of acute care setting based on patients' needs as identified by the different stakeholder groups (including patients and their families). Initial ideas under this theme were that modern hospitals could not be seen as institutional environments and design became driven by creating an enhanced patient experience, much more related to a hotel-like experience in terms of services and homely like in the way it looks. Design principles related to this theme aimed at increasing in-patient satisfaction levels and making acute care environments less 'stressful' for those going through difficult times. The use of coordinated colour schemes, and neo decade-specific décor in non-clinical communal areas were some of the ideas used to make an environment more patient-centred. Also, programmes mixing single and multiple occupancy and coordinated signage to support wayfinding were part of a patient-centred environment.

Healthcare Re-Configuration

At the beginning of the 21st century it became clearer that there were threats and challenges in terms of healthcare funding and that the transit of people within hospitals could offer an opportunity to change the configuration of acute care buildings. In an attempt to diminish the running costs of facilities on public pockets, ideas exploring the generation of revenue became more common to the development brief of new healthcare buildings. The new brief would contemplate spaces such as banking, training, cafes and retailing areas that are run by third parties. The incorporation of such ideas was not only incorporated to generate additional revenue but also to give patients and visitors a wider range of things to occupy their time. Clearly, the idea was very well received by the private sector, despite concerns related to the security and safety of patients, visitors and staff.

Service and Building Design Integration

Under the integration theme came the idea that service design impacts on building design and vice-versa. As such, co-location and integration of services was sought as a way to positively impact on patients' health, on levels of staff turnover and on care provision. In general, the idea is to understand how healthcare services change through time so as to make the building design more flexible, adaptable and expandable thus minimising the need for constant refurbishment and reconfiguration whilst also allowing space for decanting activities when unforeseen changes are needed. This idea was of particular relevance at a time when the healthcare system became more centralised and where Strategic Health Authorities would define where and which services would be delivered based on proximity to patients, the need for services and specialisms and the available capacity.

Co-Design

Co-design is a process-based idea where the client has a share of direct or indirect responsibility in defining the final product. Within this process, in addition to design expertise, the designer also has the additional role of acting as a facilitator. In general that involves managing stakeholder groups (such as clinical staff, patient groups, heritage, etc.) with regards to their expectations, wishes and needs where the designer works closely to the end-users (Bate and Robert, 2006; Sanders and Stappers, 2008). This approach is still widely used in projects where public funding is used for financing the project. Terms that became commonly associated with co-design include 'benefits realisation' and 'fit-for-purpose' facilities.

Information Modelling and Management

It is not only the design solutions that are changing in the context of healthcare design. The design process as traditionally know has changed considerably in the last decade and more so in the last 5 years, since the run up for BIM adoption on complex projects (Sebastian, 2011). The possibility of creating a digital model that contains information from the different design, engineering and management disciplines is enhancing our understanding of the inter-relationship amongst design solutions. It is fair to say that the engineering disciplines are benefiting more. That is because it is easier to simulate the performance of the physical aspects of the building and its inhabitants than the psychological ones. However, we are not far the time when digital models will incorporate intelligent hard and soft information about building occupants.

Therapeutic Environments

The idea of therapeutic environments is not new. Ideas around space design and its impact on our healing process can be seen as far back as Hippocrates (400BC). From time to time, these ideas get new insights and, as a result, hospitals gain new configurations. The work of Florence Nightingale (1863), for instance, discussed principles of hospital design and how light and air could improve the healing process. In the 1930s the field of environmental psychology emerged, gaining worldwide momentum in the 1950s and again in the late 1990s and 2000s giving rise to the dissemination of the evidence-based design (EBD) approach. Amongst the ideas presented, this is the one that still remains strong for many reasons. For Lawson and Phiri (2000), the operational savings resulting from an evidence-based design approach can be in the region of 20% per annum. The design ideas used in therapeutic environments connects the fabric (colour, materials, systems, etc), the ambient (light, temperature, noise, etc) and the psychological aspects of spaces (crowd, density, privacy) with healing (Cooper *et al*., 2008). Several guidance articles CABE (2006), Kings Fund (Waller and Finn, 2004; Waller *et al*., 2013), AEDET, ASPECT and IDEAS (Lawson, 2010; Phiri, 2015) were developed in the UK to support practice. Due to its importance, this theme is further discussed in detail in the following sections.

New episteme: Shifting to Evidence Informed Design

Quite convincingly we can think that the idea of therapeutic environments and evidence-based design (EBD) is the solution for designing acute care settings. We argue here that it can help, but not in the ways most people may think. To explain that, we introduce the general idea of Evidence-Informed Practice which is used in this section as a derivative of the term Evidence-Based Practice (EBP), which in turn is an extension of the idea of Evidence-Based Medicine (EBM) applied to various fields including management and design. For design, arguably the strength of EBP is its reliance on the systematic way in which evidence is collected from rigorous scientific reports and incorporated into decision-making in the design process (Malone *et al*., 2008). Likewise, in medicine this approach has been used to support decisions made between doctors and patients on the best treatment alternative for patients based on individual clinical expertise with the best available external clinical evidence from systematic research (Mulrow, 1994; Sackett *et al*., 1996). At first sight the idea is so logically rational that it developed in many other areas such as education (e.g. Reed *et al*., 2005), economics (e.g. Pignone *et al*., 2005), management (Tranfield *et al*., 2003) and design (Malkin, 2008).

For design, EBD is defined as "…a process for the conscientious, explicit, and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project (Hamilton and Watkins, 2009) … with the goal of improving outcomes and of continuing to monitor the

success or failure for subsequent decision-making (Malkin, 2008)". For Fischl (2006) this approach aims to provide scientific evidence for bridging designers' knowledge gap about humans' social and behavioural attitudes towards the surrounding environment. In this respect, the designer acts as a 'researcher' working as an interpreter in investigating and describing human behaviour needs.

This approach implies a change in the traditional practice of design. Designers are increasingly required to have a considerable amount of expert knowledge that is beyond their own field (Hamilton and Watkins, 2009); for instance, familiarity with multidisciplinary terms. For Hamilton and Watkins, this happens especially because building projects have become more complex as more efficiency and strong links between buildings and services delivered within them is required. Thus, by following this route, it is expected that risks related to design solutions could be reduced up front once evidence is available to demonstrate the efficiency and effectiveness of tested solutions (CDH, 2008).

In practice, design solutions have to comply with socio-technical regulations, norms and principles that are put in place after thorough tests have been carried out to set out the standards with which to comply (e.g. norms for health and safety, ergonomics, density, etc). Such a regulatory system started to be developed in the 1960s by the UK National Health System (NHS). The NHS developed design guidance for the construction of healthcare environments and, to date, there are approximately 70 Health Building Notes (HBNs) and 240 Health Technical Memoranda (HTMs) that were developed with a basis in evidence and good practice.

Despite the proclaimed importance related to the use of evidence in design, not much can be said about the process steps for its implementation (e.g. Malone *et al.*, 2008; McCullough, 2010; Evans, 2010; Codinhoto *et al.*, 2009). Malone *et al.*, (2008) can be considered the only guidance available, which contains directions for the implementation of EBD through the 8 process steps that include: a) the definition of evidence-based goals and objectives; b) the definition of sources providing relevant evidence; c) the critical interpretation of relevant evidence; d) the creation and development of EBD concepts; e) the development of a hypothesis linked to a design proposition; f) the definition and collection of baseline performance measures; g) the monitoring and implementation of the solution within design and construction; and h) the measurement of post-occupancy performance results.

The use of this approach does not come without challenges. As argued in Codinhoto *et al.*, (2009), those unfamiliar with the approach may have difficulties in setting clear aims and objectives. In addition to that, the data source is widespread, fragmented and its compilation and analysis can be confusing due to the different methods used to gather evidence. Also, as highlighted by Lawson (2010) we may want to introduce evidence-based design to our healthcare buildings, but we do not want them to become standardised solutions independent of place, culture and raw creative innovation. However, going through this process is enlightening as it questions the way designers make decisions.

For those willing to use EBD, two activities are very important. First is the systematic compilation, comparison and contrasting of existing evidence through a systematic literature review; second is the development of a method for the collection of empirical evidence after building occupancy. According to Hamilton (2012), EBD currently follows mostly the latter approach and in spite of the added managerial complexity of the design process, it supports the resolution of design trade-offs.

In medicine, the compilation of evidence leads to the development of 'evidence models' that demonstrate multi cause-effect networks (Mulrow *et al.*, 1997). Currently, these 'of the self"

models do not exist for design and must be developed by the design team on a case-by-case. To illustrate what an evidence model is, Figure 1.1 presents an example developed with a basis on causality and clinically meaningful outcomes relating the built environment and wellbeing. Each arrow represents a possible cause-effect relationship for which research can be conducted (note that the evidence that supports the model is not presented in the links) and only after research is conducted (or found) can the links be confirmed (or disconfirmed) and validated.

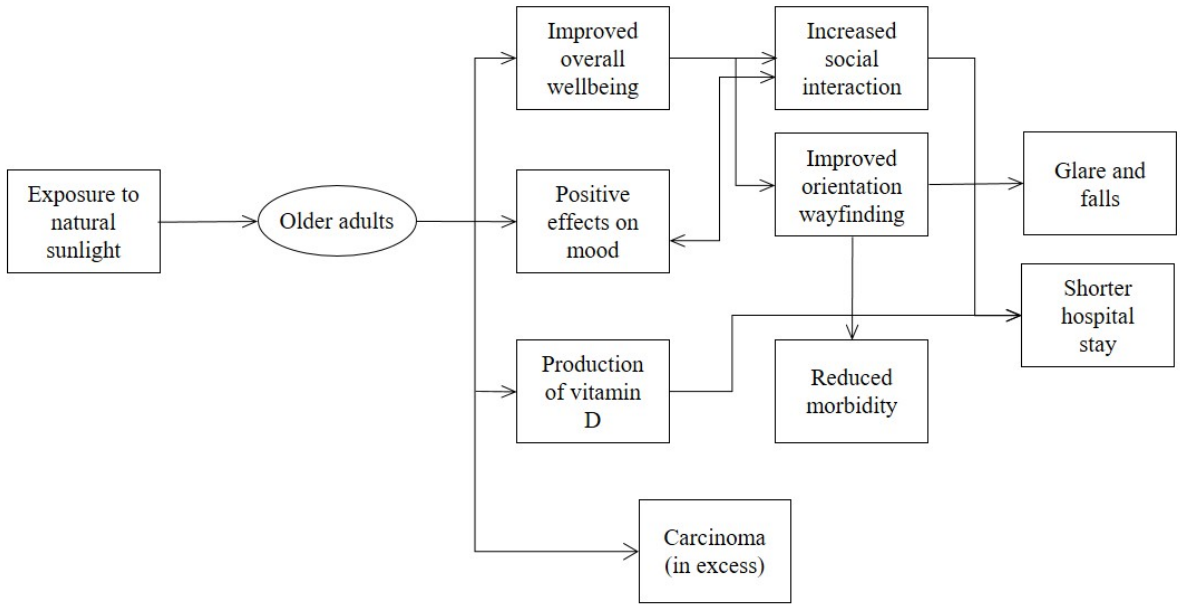

Figure 1.1 - An evidence model for the effects of exposure to natural sunlight on older adults

In relation to design, the only attempt found that suggests a classification of evidence and a route for incorporating evidence within design is present in the work of Evans (2010). Evans claims that there is a need for proper understanding about how to fill the 'application gap' that links evidence and designing. He suggests revisiting the argument of Hillier *et al*. (1972) that substitutes the Analysis-Synthesis-Evaluation design process in favour of Popper's Conjecture-Analysis (Branford, 2002). He then suggests that evidence, to be useful for designers, must be part of 'conjecturing' so as to be used as propositions to support problem finding rather than being used as rules (solutions). However, Evans highlights that the character of evidence generated by science is significantly analytical (too specific) and therefore constitutes a barrier for the implementation of his own suggested approach.

In this respect, Evans' point of view is correct, i.e. design can only be 'informed' rather than 'based' on evidence. Epistemologically, it is impossible to rationally use external evidence from past projects into new ones[1]. The current shift in practice is also aligned with this idea, where studies can generate insights for designers, but the validation of each solution is investigated within its own context, with its own variables and as part of a design composition. In other words, there are difficulties in generalising results as designed environments are the result of compositions created with different material and non-material features that generates space and place. For that reason the term Evidence-Informed Design best represent what can be achieved in practice.

[1] A thorough justification for this statement is presented in Codinhoto (2013).

Health, Person and Place

To provide an in-depth account of all there is that links the built environment and wellbeing in acute care settings would require, perhaps a whole series of books to discuss the different approaches that there are to investigate this issue. Here, three fundamental aspects are discussed that are relevant: health, place and person.

Health

There are a variety of models, typologies and theories of health and wellbeing out there (e.g. Bergner, 1985; Patrick and Bergner, 1990; and Johnson and Wolinsky, 1993). These models tend to consider measures of health and wellbeing based on physical, physiological or psychological outcomes separately. Conversely, Wilson and Cleary (1995) proposed a conceptual model of health-related quality of life, of which the spectrum of outcomes range from biological to psychological aspects. This model has been highly influential in medical research (Ferrans *et al*., 2005) and as such it is used here as a major reference to the topic. According to Wilson and Cleary (1995), there is a wide spectrum of alternatives for measuring health or the lack of it. They argue that disturbances in health can be perceived at molecular and genetic levels at the one end as well as being broad and subjective measures such as 'feeling well' at the other. According to Wilson and Cleary (1995) there are at least five (relevant and practical) different levels of health outcomes: Biological and physiological factors; Symptoms; Functional status; General health perception; and Overall quality of life.

Although Wilson and Cleary (1995) argue that molecular and genetic factors are the most fundamental determinants of health status, their model begins with biological and physiological factors because they are more commonly conceptualised, measured and applied in routine clinical practice. Furthermore, in relation to the measurement of health disruption, there are a considerable number of methods and tests for doing so, varying from interviews and the application of questionnaires to patients and their families to highly technological investigations and tests conducted in controlled environments (e.g. blood tests, scans, biopsies, DNA tests, etc.). In addition, Wilson and Cleary argue that there are no clear boundaries between their suggested levels and this is because one level may influence the other. Finally, they argue that health outcomes are influenced by the individuals' characteristics as well as by the characteristics of the surrounding environment.

In this respect, Wilson and Clearly (1995) and Ferrans *et al*. (2005) consider that the environment has an indirect (rather than direct) impact on patients. For instance, Ferrans *et al*. (2005) consider that characteristics of the environment can be either social or physical. Social characteristics include, for instance, the marital status and the interaction between couples. It also includes the social milieu where the patient interacts, such as the specific culture of a haemodialysis clinic, waiting rooms, etc. Physical characteristics, on the other hand, include the distinctive attributes of settings that may influence health outcomes, such as neighbourhood pollution or exercise facilities. According to Wilson and Cleary, 'biological and physiological variables' is the only category that is not affected by the environment and the characteristics of the patient. These authors do not explain why this is. In principle, any health disorder can be captured through Wilson and Cleary's model.

Person

With regards to the person, the number of variables that could possibly characterise patients is considerably large. According to Wilson and Clearly (1995) this is because the characterisation of individuals is also dependent on the health condition of the individual. In this respect, Ferrans *et al*. (2005) argues that there are four categories of characteristics: (a)

demographic; (b) developmental stages; (c) psychological; and (d) biological factors that influence health outcomes, as described below.

We introduce here three other categories to the taxonomy developed by Ferrans *et al*., (2005) that are related to patients' contextual information: first, the condition of the individual in relation to the intervention to promote health (e.g. pre-and post-operation, during treatment, etc.); second, the type of treatment as related to physical intervention (e.g. surgery), the use of drugs (e.g. chemotherapy, corticoids, etc.) and psychological or psychotherapeutic procedure; and finally, the disease or injury incurred.

In principle, any person can be characterised through this model. However, it is important to highlight that this taxonomy of individuals' characteristics is not exhaustive. For instance, cultural, social and economic characteristics are not included in the model.

Place

The literature about healthcare facilities design (e.g. Kliment, 2000; Miller and Swensson, 2002; Malkin, 2008; Grunden and Hagood, 2012; Purves, 2012; and Clarke, 2012) is, in general, focused on the functional decomposition of the building; for example, by considering main unit areas within hospitals, such as Intensive Care Units (ICUs), Maternity, Accident and Emergency (A&E) amongst others. Once each unit is defined as part of the programme, the next step is to define the rooms within each care unit such as wards, waiting areas, examination rooms and so on.

In spite of differences in nomenclature patterns, the presence of one dimension does not necessarily exclude another. In other words, a building type will accommodate many care units that will have within them many settings that are in turn defined by components, furniture and equipment and sub-systems that perform certain functions. At the end of this spectrum there are characteristics that are the minimum elements that ultimately descriptively characterise a space. However, this type of arrangement makes collecting evidence more complex. This is because one characteristic can affect people differently, unless proven otherwise. Thus, collection evidence for every possible combination of characteristics and settings is almost impossible. Considering this complexity, we propose a classification that includes the specialist type of building (e.g. primary, secondary, tertiary care), care unit (for instance, coronary, A&E, maternity), setting (such as ward, waiting room and operation theatre), component (e.g. wall, celling, door, window), furniture and equipment, sub-systems (for example, air-conditioning, and ventilation systems), and functions and characteristics (such as colour, texture and light).

Below we present a *Health, Person and Place model* that brings together the discussion presented above. Figure 1.2 summarises the issues that are relevant for the design of acute care facilities when considering an evidence-informed approach. It shows the health outcomes as identified by Wilson and Cleary (1995), the person's characteristics as discussed by Ferrans *et al*., (2005) and the characterisation of places. In the following section, pieces of evidence are presented to introduce key areas of research linking acute care settings and wellbeing.

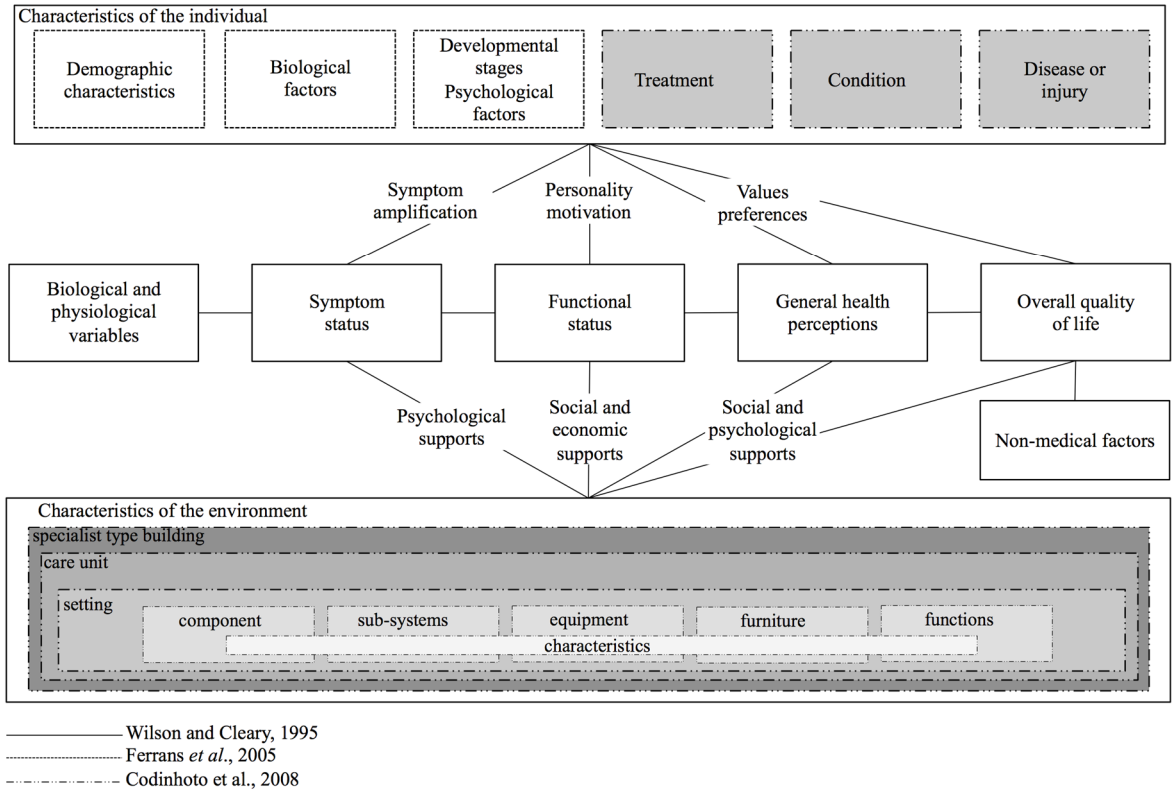

Figure 1.2 – Health, Person and Place model

What to Expect When Using Evidence to Support Design

As discussed in the previous section, evidence will appear in all sorts of shape, size and strength. Anyone attempting to collect evidence will be tempted, soon after starting, to create groups of interconnected findings. The task can be simplified if the designer considers issues related to the scale of observation where the evidence was gathered. The idea of defining a specific setting and finding evidence about design characteristics can help. However, scientific evidence, when presented in the format of systematic reviews such as Devlin and Arneill (2003) and Ulrich *et al*. (2004, 2008), emphasises specific features such as light, colour, noise, wayfinding, etc. In this case, the narrative about the functional area investigated is not necessarily always explicit, thus leading to questions related to generalisation of evidence.

The literature is also rich with regards to the background of the researchers. The subject of built environment and wellbeing has received multidisciplinary attention from designers, architects, artists, engineers, psychologists, environmental psychologists, physicians and nurses, amongst others. Clearly that has led to a large plethora of subjects being explored. In architecture, for instance, considerable attention has been given to design solutions that improve patients' experience (e.g. CABE, 2006; Malkin, 2008). In engineering, research has been focused on the investigation of systems and the improvement of systems' performance (e.g. ventilation, illumination and air conditioning) and how the improvement of these systems affects health and care delivery (e.g. Chow and Yang, 2003).

With regards to impacts on health and wellbeing, the literature brings not just positive, negative and neutral results; some cases also show effects and side-effects of the solutions. That is the case when a design solution is analysed in relation to the different outcomes that a single characteristic can produce. This problem was already well described in the seminal

Nuffield Provincial Hospitals Trust (NPHT) Report in 1960. According to the NPHT, natural sunlight is a characteristic that may have both a positive and negative impact on wellbeing. On the one hand, it is effective in reducing the levels of *haemolytic streptococci* bacteria, but if the design does not consider the amount of glare generated it may cause discomfort to the patient, therefore leading to falls. Understanding the chain of effects is very important and assembling evidence models assist with a general understanding.

Finally, existing evidence linking the built environment and wellbeing explores different aspects of design. The main dimensions studied include the physical dimension or materiality (e.g. material, colour, texture), the environmental dimension (e.g. temperature, ventilation, dimensions), an aesthetic/composition dimension (e.g. symmetry and balance) a functional dimension of the space (e.g. privacy and maintainability) and a psychological dimension (e.g. crowdedness, secureness, homeliness, etc.). The deployment of these dimensions into their variants is presented in Table 1. Each dimension can be measured in different ways and therefore amplifying the possibilities of establishing relationships between the built environment and wellbeing. For Cooper *et al*. (2008) there are three generic categories that agglutinate these dimensions: the fabric of the environment, the ambience of the environment, and the psychological impact of buildings upon humans. The fabric of the environment includes the design and construction of buildings (e.g. floors, walls, doors, ceilings, windows) and the spaces between buildings (e.g. gardens, paving). Consideration should be given to the use of colour (e.g. red, blue, yellow); texture (e.g. rough, smooth, silky); pattern (e.g. checked, stripes, flecks); material (e.g. wood, metal, rubber) and structure (e.g. hard, soft, firm). The ambience of the environment pertains to the surrounding character and atmosphere of the environment. This includes noise (background, white-noise, silent, loud, constant); lighting (harsh, stark, mellow, bright, dim); temperature (cold, hot, mild); colour (warm, cool, cheerful, natural, subdued); air quality and ventilation (clear, polluted, dirty, fresh); humidity (damp, dry) and views of nature (natural sunlight). The psychological impacts of the environment are the perceptions of the physical environment and its impact upon individuals such as density (e.g. crowding, desolate); sense of safety or fear; way-finding (e.g. easy, hard, and confusing); accessibility (e.g. difficult, direct, and easy, off putting) and identity (e.g. homely, clinical, institutional, traditional or modern).

Table 1 – Characteristics and their variants in healthcare facilities

Variables	**Variants**
Lighting	natural light, artificial light, different types of artificial light
Colour	yellow, orange, red, black, white, blue, green, grey
Pattern	stripes, dots, chequerboard, plain
Textures	smooth, rough, silky
Ventilation	natural ventilation, artificial ventilation
Temperature	cold, hot
Dimension	size, height, width, depth
Material	carpet, copper, steel, aluminium, plastic
Composition	symmetry, balance, rhythm, movement, hierarchy

Results from systematic reviews (e.g. Ulrich *et al*., 2004; 2008) show that the range of studies varies considerably from a holistic viewpoint to a reductionist one. Examples of the holistic approach are presented in Qatari (1999) and Leather *et al*. (2000). In both studies, specific areas within hospitals were investigated in relation to clients' satisfaction and improved wellbeing. Examples of the reductionist approach can be found in Wilson, (1966); Nourse and Welch (1971); Jacobs and Hustmyer Jr. (1974) and Jacobs and Suess (1975) in relation to the use of colour and its psychological impacts on people within a specific setting and

circumstance. Another example can be found in Chow and Yang (2003) who investigated the performance of ventilation systems in relation to temperature control in a non-standard operating room. Chow and Yang (2003) concluded that the appropriate ventilation and temperature (in terms of effectiveness in 'washing' bacteria during an operation) might cause discomfort for staff whilst using the space. In addition, it is clear that certain features of the environment are influenced by more than one characteristic. Luminosity within a setting, for instance, can be influenced by the amount of light from natural and/or artificial sources and the colour of the surroundings. In this respect, its perception will also vary: for example, we lose sight capacity with ageing, thus an older person will not perceive the environment in the same way that a younger person does.

Pieces of Evidence Linking the Built Environment to Wellbeing

A few studies amalgamate a large number of research findings relating the built environment to health and wellbeing. The work of Devlin and Arneill (2003); Ulrich *et al.*, (2004, 2008) and Lawson and Phiri (2005) are amongst those with considerable breadth of work. Here, I do not intend to provide an extensive list of studies, but rather to give examples of research in the area. The list of studies linking the built environment and health outcomes is presented discussing the following individual characteristics within the ambience of the environment: lighting, ventilation, temperature, arts and acoustics. The effects of other environmental variables are also summarised.

In relation to the health outcomes identified, a large proportion are related to psychological disorders as opposed to physical ones. In this respect, the results of the review indicate that outcomes are sought in relation to the presence or reduction of symptoms and improvement of the functional status of the studied groups. In addition, emphasis is placed upon non-medical outputs, such as the overall performance of the care provider in relation to the whole population of patients visiting a particular care institution. In relation to this aspect, results can also be positive or negative. Finally, both positive and negative outcomes (for medical and non-medical categories) can also be measured to different degrees, e.g. relevant or irrelevant to health enhancement or decline.

Lighting

The literature indicates that light (natural or artificial) can be associated directly and indirectly with physical, physiological and psychological health outcomes. In this respect, excessive exposure or the lack of exposure to light can have negative impacts on health. Examples of outcomes that are related to light exposure include retinopathy, seasonal affective disorder and melanoma. Conversely, appropriate light exposure is considered to have stimulating properties that affects metabolism and mind. Examples of studies investigating light and its impact on health and wellbeing are presented below:

- Fluorescent light: excessive exposure has been associated with increased risk of developing melanoma in adults (Beral *et al.*, 1982); bright fluorescent light was associated with beneficial effects on seasonal depression. The same effects were not verified on non-seasonal depression (Kripke *et al.*, 1982; Kripke *et al.*, 1983; Yerevanian *et al.*, 1986; Kripke *et al.*, 1998);
- High levels of ambient illumination contribute to the incidence of oxygen-induced retinopathy of premature infants (Glass *et al.*, 1985). Controversially, a study conducted by Ackerman *et al.* (1989) concluded that there was no difference in the incidence and severity of retinopathy of premature infants. Ackerman *et al.* (1989) also identified that shielding

infants in isolation from incidental lighting has no effect on the development of retinopathy of premature infants;
- Cycled light: exposure was associated with infants' superior rates of weight gain, faster development of the capability of being fed orally and enhanced motor coordination when compared with non-cycled light (Miller *et al.* 1995);
- Light in intensive care units was associated with variability of patients' sleeping patterns (Richards and Bairnsfather, 1988); low frequency (red) light waves were associated with less sleep-wake frequency and more sleep thereby contributing to night sleeping. High frequency (blue) light waves were associated with greater sleep-wake frequency and more waking, thus contributing to day waking or being useful for undesirably sleepy neonates (Girardin, 1992);
- Daylight: exposure to ultra-violet radiation was associated with metabolic stimulation and increased production of Vitamin D (Veitch and McColl, 1993).

Ventilation

Both natural and artificial routes can be used for building ventilation. The literature shows that research related to artificial ventilation and its impact on health outcomes are mainly associated with the dissemination of airborne types of disease. Research about natural ventilation is mainly related to window types and sizes. However it can be associated with different levels of pressure between adjacent rooms (e.g. bedrooms and corridors). The identified issues are presented below:

- Room Pressure: reduction of nosocomial infections through the adoption of negative pressure in settings occupied by infected patients (Anderson *et al.*, 1985); Increased risk of airborne bacteria contamination from the surgical team on the patient, and vice versa through the ventilation system (Chow and Yang, 2003);
- Humidifiers: contamination by acremonium kiliense conducted through the humidifier water used in the ventilation system (Fridkin *et al.*, 1996); recommendations for the use of heat and moisture exchangers in patients with acute respiratory failure (Pelosi *et al.*, 1996);
- Combined artificial and natural ventilation system: contamination by staphylococcus aureus (MRSA) (Cotteril *et al.*, 1996); tuberculin conversion among healthcare workers was strongly associated with inadequate ventilation in general patient rooms (Menzies *et al.*, 2000); Charles (2003) presents a compilation of studies looking at comfort generated by the use of localized air distribution systems.

Temperature

Effects of ambient temperature on humans, such as morbidity, stress, cardiovascular and cardiorespiratory episodes are well known. Considering that in hospitals indoor temperature is expected to be stable, the research in this filed is, in general, related to patients' control over ambient temperature rather than the effects of variance in temperature ranges. The literature also demonstrates that there are many parameters that are used to specify the temperature performance of indoor environments that rely on both subjective and objective indicators (Fransson *et al.*, 2007) and these may vary as they are provided by different organisations such as ANSI/ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) and the ISO (International Standards Organisation). Examples of research related to indoor temperature are presented below.

- Stress: Bell and Green (1982) investigated the impact of temperature on physiological stress; results of the impact of thermal stress is presented in Hickam *et al.* (2003); Lu and

Zhu (2006) investigated the heat stress and heat tolerance of 148 males. The study proposed physiological limit values at exposure limits;
- Comfort: temperature related comfort of staff in operation theatres was studied by Chow and Yang (2003) and Hwang *et al.* (2007);
- Ceiling Radiant Cooling Systems: Nagano and Mochida (2004) investigated the control conditions of ceiling radiant cooling systems and concluded that some measures and parameters that have been used in design should be reviewed;
- The dissemination of waterborne infections due to warm temperature conditions is presented in Joseph (2006b).

Acoustics

The investigation of acoustics characteristics is mainly related to noise and its effects on health. In general, noise is associated mainly with sleeplessness and stress. The root causes of noise varies and is associated with the operation of machines, equipment and tools, staff conversation and transportation of equipment within the facility (Christensen, 2004). It was found that music and music therapy (e.g. Cabrera *et al.*, 2000, Devlin and Arneill, 2003; Ikonomidou *et al.*, 2004 and CABE, 2004) has the potential to enhance wellbeing. A review of research within this topic is presented by Konkani and Oakley (2012). Other examples of research include:

- Comfort and recovery: noise disturbance produced by the operation of the facility negatively impacting on patients' comfort and recovery (Bayo *et al.*, 1995); Allaouchiche *et al*., (2000) found that noise levels above 40dB does not affect post-anaesthetic patient's comfort.
- Stress: noise produced by the operation of the facility was associated with stress (Topf, 2000; Topf & Thompson, 2001); nurses increased levels of stress due to noise were found by Morrison *et al.*, (2003). Noise levels were measured in ICU units by Christensen (2007).
- Psycho-physiological effects (e.g. decreased wound healing, sleep deprivation and cardiovascular stimulation): Christensen (2004) investigated excessive noise generated by building occupancy (staff, patient and visitors) and found a correlation between an increased number of people and substantial noise increase. Noise produced by the operation of the facility was associated with sleep disturbance (Richards and Bairnsfather, 1988; Haddock, 1994; Topf *et al.*, 1996; Ersser *et al.*, 2001); noise levels above the international recommendations were found in operating theatres. The measured noise levels exceed the thresholds to produce noise-induced cardiovascular and endocrine effects (Liu and Tan, 2000);
- Patient experience: noise produced by the operation of the facility was associated with patients' bad experience of healthcare service (Douglas and Douglas, 2005).

Art

Art and mental health have been investigated from a myriad of perspectives. These include the use of music with particular attention paid to different types of instruments; the use of live, video or recorded performances; drawings and paintings; and traditional and contemporary art (Staricoff, 2004). The existing literature also distinguishes between art therapy (i.e., the effect of actively getting involved in the development of art work) and the passive exposure to art in specific environments within healthcare settings (Daykin and Byrne, 2006). These authors argue that few controlled and randomised studies of the therapeutic effects of art in mental health have been carried out. Literature reviews specifically looking at art and mental health include ones by Staricoff *et al.* (2003), Staricoff

(2004) and Daykin and Byrne (2006). Other reviews, such as Devlin and Arneill (2003) and Ulrich *et al.* (2004), also consider the impacts of art on health; however, these reviews are focused on the impact of the physical environment (rather than the built environment) on health. Art and health related investigations are presented in the following:

- Mental health conditions: A study conducted by Ulrich (1992) revealed that inappropriate visual art styles are related to the disturbance of mental health conditions; according to Philipp *et al.*, (2002), the arts can help mitigate mental health conditions, such as depression, anxiety and low self-esteem. For Philipp *et al.*, art also supports the improvement of social integration and isolation. There is a diverse range of art activities that are incorporated into the study of art and mental health care;
- Stress: Mornhinweg (1992) found a significant reduction of stress levels by using patients' pre-selected music in the background; Biley's research (2000) indicates positive (but inconsistent) changes in physiological variables measured; Gerdner (2000) showed that classical music impacts positively in the reduction of levels of agitation of patients with Alzheimer's disease; McGarry and Prince (1998) and Korlin *et al.* (2000) argue that creative arts programmes induce significant improvements in the communication of psychiatric patients;
- Pain relief: results presented in Onieva-Zafra *et al.* (2013) shows a correlation between pain reduction and music therapy. Gutgsell *et al.* (2013) observed a similar relationship for patients undergoing palliative care and Vaajoki *et al.*, (2012) for post-surgery patients.
- Research results presented in literature reviews, such as Staricoff (2004) and Daykin and Byrne (2006), suggest that the arts can have a therapeutic effect on people suffering with mental disorders. However, Staricoff (2004) draws attention to the fact that the introduction of creative arts, such as dance, drama, music, visual arts and creative writing in mental health can also bring with them potential risk factors. These are associated with the psychological effects of being engaged in these activities, which could become too demanding for the patient (Staricoff, 2004).

Colour

There are different assumptions about how colour affects humans (Dalke *et al.*, 2006). For instance, there is anecdotal evidence speculating that red, orange and yellow in shiny and polished surfaces stimulate appetite and anxiety (this would explain why these colours are very often used by fast-food chains). Grey, purple and red have been associated with depression and are excluded from the palette of colours of designers designing hospices and psychiatric hospitals. Some other examples of studies about colour and health are presented below:

- Physiological effects (e.g. respiration and heart rate): the study about the effects of red, yellow, green and blue concluded that there is no significant effect of these colours on respiration rates (Jacob and Hustmyer, 1974);
- Anxiety and Stress: the study about the effects of red, yellow, green and blue (in non-healthcare environments) concluded that red and yellow can be associated with high levels of anxiety and that blue and green can be associated with low levels of anxiety (Jacob and Suess, 1975; Rabin, 1981; Steffes and Thralow, 1985; Edge, 2003; Connellan *et al.*, 2013); the effects of colour on stress and arousal levels in healthcare environments is also discussed by Dijkstra *et al.* (2008).
- General studies on colour: Etnier and Hardy (1997) studied colour influence on the performance of mentally and physically demanding tasks; Kaya and Crosby (2004)

investigated individuals' colour associations with different building types; the effects of colour in hospital design are discussed in Dalke *et al.* (2006).

Layout

The layout of a setting within acute care facilities is another aspect that affects the way humans behave in general (Zimring *et al.*, 2005), and specifically the way patients and staff react to the environment (e.g. Leather *et al.*, 2003a). There are several aspects associated with the layout of the facility or the setting under investigation (NHS Estates, 1999). Privacy seems to be one of the most investigated features, which has been mainly associated with occupancy. There are a variety of studies stating that single occupancy bedrooms increases privacy and, therefore, it is better for patients and staff because it reduces noise levels and consequently improves sleep rates and reduces stress, and reduce the risk of infections. However, anecdotal evidence indicates that single occupancy rooms are not preferred by patients aged above 45 years of age with a working and middle class background. Examples of studies looking at these issues include:

- Occupancy and privacy: Evans and McCoy (1998) and Altimier (2004) associate occupancy and privacy with the development of the social environment, which is relevant to patients recovery; Grosenick and Hatmaker (2000) associate privacy as one important building characteristic to be considered in the treatment of substance abuse; Chaudhury *et al.* (2005) present a review of the advantages and disadvantages of adopting single and multiple occupancy bedrooms. Improved healthcare experience associated with privacy and occupancy is presented by Douglas and Douglas (2004, 2005);
- Wayfinding: O'Neil (1991) and Passini *et al.* (2000) explore layout and wayfinding in a nursing home for advanced dementia of the Alzheimer's type; Baskaya *et al.*, (2004); Rooke *et al.*, (2009) and Rooke (2012) discuss this aspect of how the knowledge embedded in objects in healthcare settings support wayfinding;
- Social Interaction: whilst providing spaces for privacy is relevant, of great importance is also the provision of spaces for social interaction. This issue is explored in the work of Hair (1998), Fottler *et al*. (2000), Douglas and Douglas (2004) and Rollins (2009).

Gardens and other green spaces

Finally, positive health outcomes are perceived as related to the exposure of, or having access to, gardens and other green spaces. Some of the outcomes include the reduction of stress and levels of anxiety, increased social interaction, and an improved healthcare experience. Researchers looking at this issue include arguably Ulrich (1981, 1984, 1992) Ulrich *et al*., (2004, 2008); Marcus and Barnes (1999), Marcus (2000), Kaplan (2001), Whitehouse *et al.* (2001); and Milligan *et al.* (2004). The incorporation of garden spaces within hospitals has increased in the UK as an alternative to the creation of meaningful activities that keep patients (particularly older patients with dementia) occupied whilst in contact with nature (Söderback *et al.*, 2004). Access to nature is a subject that in 2015 started gaining momentum again and new evidence related to the impact of accessing nature within hospitals or in our daily lives is expected to emerge.

Practical Implementation at Brighton's 3Ts

To conclude this chapter, a case still under development in the UK is presented and by contrasting current versus enhanced design we aim to illustrate the direction for architectural design of acute care settings.

Over the past 8 years I have been following the re-development of the Brighton and Sussex University Hospitals (BSUH), for ease referred to from henceforth as 3Ts (for Teaching, Trauma and Tertiary Care). The 3Ts hospital is currently an acute teaching hospital working across two sites: the Royal Sussex County Hospital (RSCH) in Brighton and the Princess Royal Hospital in Haywards Heath. The project redevelopment is focused on the RSCH site. Figure 3 depicts the current RSCH complex with a wide range of buildings, located in central Brighton. The tall buildings in the centre as well as the smaller ones in front of them constitute a rather fragmented hospital complex which imposes difficulties of navigation for patients, staff and visitors and inadequacies of space provision to accommodate patients and current and state-of-the-art equipment.

Figure 1.3 – RSCH complex before redevelopment in 2014.

Current Facilities

The redevelopment of the 3Ts hospital is needed for many reasons. The main existing buildings were built nearly 200 years ago (Barry Building was built in 1828 before guidance on hospital design from Florence Nightingale was available). Currently the wards and other clinical and public areas are inadequate and not fit for the delivery of a multitude of care services such as treatment for cancer, infectious diseases and HIV, imaging and cardiac investigations. Changes in technology have also had an impact. Large size imaging machines simply do not fit in spaces that were not designed for them. More complex is the fact that trauma and neuroscience services are located in different buildings located considerably far from each other. Which means that currently a person with serious body and head injuries cannot be treated in the 3Ts hospital. In the following, issues demonstrating the need for the redevelopment are presented.

Parking at the 3Ts Complex is situated in a central area of Brighton and spaces are less than ideal with regard to allowing easy wayfinding to the main entrances in the case of emergencies. As shown in figures 1.4 and 1.5 there is no control regarding available spaces near the entrances. This type of configuration is commonplace and a cause of distress for patients and families trying to access care services. There is no single entrance to the many buildings and finding a parking space in a moment of emergency is considerably challenging and can consume critical time to care.

Figure 1.4 – Current Car Parking

Figure 1.5 – Current Car Parking

Reception areas are the first place patients will look for to gather information regarding their appointment. Figure 1.6 shows an example of a reception desk area that is not fit for purpose, as it does not allow conversations between staff and patients in wheelchairs. Also, the signage hanging from the ceiling is not at sight level for older people and there is no place for confidential conversations.

Figure 1.6 – Current reception desk

Examination rooms' main issues are related to clutter from non-integrated equipment. As technology has developed through time, different pieces of kit were incorporated to clinical spaces in an *ad hoc* manner (Figures 1.7 and 1.8).

Figure 1.7 – Examination room

Figure 1.8 – Examination area

In the past, **wards** used to be open spaces with a series of beds separated, or not, by small barriers such as curtains. Currently, this model does not provide for today's demands of privacy, dignity and infection control. The small size of wards and the amount of equipment used in modern care makes the space cluttered, thus creating difficulties for maintaining good infection control practice. Less than 5% of the beds in the Barry Building are in single rooms and the number of toilets per person is below modern standards (Figures 1.9 and 1.10). The space available for staff to perform services (such a bathing patients or simply moving patients within their beds) is below current national standards for manoeuvre.

Figure 1.9 – Current ward overview

Figure 1.11 – Single bedroom

Figure 1.10 – Current ward layout

Figure 1.12 – En suite shower room

The same principles apply to **single occupancy rooms.** New medical kits became part of care delivery leading to clutter around the patient, thus causing difficulties for staff to deliver care. Patients often feel insecure in moving around and using the toilet facilities. There are very few opportunities for making the room more homelike with personal belongings (assisting those with mental impairment – dementia) and the similarity across all rooms can lead to confusion. Despite some access to natural light, the windows located up near the ceiling do not allow patient control of the environment (Figures 1.11 and 1.12).

Nursing stations are located in areas that do not allow easy observation of patients within different wards. The areas are cluttered with equipment and information (Figures 1.13 and 1.14). The spaces are not the result of carefully thought design, but rather the consequence of constant changes happening throughout the years such as the increase of the number of patients and staff.

Figure 1.13 Nursing station - corridor

Figure 1.14 – Nursing station -ward

Corridors are endless and repetitive. Accumulated clutter and information is randomly displayed within patient routes, not considering the appropriate levels of information within the patient route. Natural light is minimal or non-existent in these environments (Figures 1.15 and 1.16).

Figure 1.15 –Information within corridors

Figure 1.16 – Clutter within corridors

Access points and circulation pathways are not ideal with regards to manoeuvrability and pedestrian zones are located adjacent to traffic areas (Figures 1.17 and 1.18). Attention that should be concentrate on patient during transportation has to be shared with distracting factors such as traffic.

Figure 1.17 – Access point

Figure 1.18 – Access point

The New Development

The new redevelopment is much needed for bringing the quality of care delivery up to 21st century standards (Figure 1.19). The design started with the redefinition of services to be delivered and its location. The new development will have 361 beds of which 75% will be single, en-suite rooms and the remaining 25% in single gender four-bed bays. The Centre for Neurosciences (currently on a split site) will be relocated alongside key emergency services,

thus avoiding the transfer of patients to already busy hospitals located in the London area. The capability of services will also be expanded for most services, such as cancer treatment with increased capacity of chemotherapy and radiotherapy services and beds on the oncology ward.

Figure 1.19 – New proposed development

The trauma centre will have a landing pad for emergency cases that together with the neurosciences centre will allow more patients to be treated nearer to home. The redevelopment will provide state-of-the-art teaching, training and research facilities, including a simulation suite for training. All these, and many other changes are necessary and will promote a positive step change in care delivery. The main ward area (the 3 blocks located on the right side) has been designed to allow more rooms to benefit from outdoor (sea) views and to maximise the use of natural light inside the wards.

Parking will be located in a colour coded multi-storey car parking with direct access to key areas (Figure 1.20) thus facilitating immediate access to the building. It is not only parking that have been thought through. Patients arriving though other means of transportation (taxi or foot) will be able to easily identify the key access areas to the hospital. External elements of the design were also included to diminish the speed of the wind on the external ground floor, also support easy access to the building. Drop off areas where designed so people can be collected without impacting on the main flows within the hospital.

Figure 1.20 – New designated parking

Receptions have been redesigned to be inclusive and to allow for privacy when required (Figure 1.21). The space have been designed to accommodate people at peak times and control measures (light and ventilation) were introduced for times when the space in less occupied.

Figure 1.21 - New universal reception

Examination rooms have been designed to incorporate state-of-the-art equipment thus avoiding clutter in the room (Figure 1.22). The space will be fully equipped with washing basins for hand washing and storage of examination kits.

Figure 1.22 – Reconfigured exam rooms

Ward design is the one that benefitted most from the redevelopment. The wards are flooded with natural light and there is adequate space for patients and staff to move around without clutter. The number of bays (4 per ward) also helps to reduce noise and whilst, it is still a shared space, privacy can be obtained by using the curtain system. The path to the toilet is visible from all beds therefore encouraging patients to use the facilities (Figure 1.23).

Figure 1.23 – Four bed bay wards with outdoor views

Single occupancy rooms have considered a plenitude of issues such as colour coded schemes to help patients with wayfinding. Much of new equipment will be wall-mounted, thus avoiding clutter and the risk of accidents in the room. There will be areas for long stay patients in to bring personal belongings (Figure 1.24). Enough space is provided for visitors and volunteers to stay with the patient.

Figure 1.24 – Single-occupancy rooms

Corridors have been reconsidered to maximise the use of natural sunlight and minimum clutter. Support handles will be available in areas where patients may need support for walking. In addition, different colour schemes will be used to facilitate navigation and wayfinding (Images 1.25 and 1.26).

Figure 1.25 – Corridor with natural light

Figure 1.26 – Colour coded corridors

Spaces for social interaction and meaningful activities were included in the design programme. These areas will allow the less vulnerable to socially engage in activities and avoid boredom. These spaces will be also available for staff break-out sessions (Figures 1.27, 1.28 and 1.29).

Figure 1.27 - Multipurpose foyer

Figure 1.28 - Multipurpose foyer

Figure 1.29 – Breakout coffee area

Spaces for meditation were considered in the project. The space, a multi-faith area, should provide privacy for those grieving or looking to meditate and pray (Image 1.30).

Figure 1.30 – Multi-faith area

Access to views and nature were created through a roof garden that also benefits from sea views. The garden was designed following principles of design for people with dementia and should support the delivery of care for these patients. The rooftop will be seen from the existing

children's hospital, thus also benefiting neighbouring buildings (Figure 1.31).

Figure 1.31 – Roof garden with sea view

Patient Public Design Panel

The design process of the 3Ts hospital had a large consultation and participation of the general public. The project director focused on the benefits realisation process and identified the key changes that were necessary to the Trust, both before and throughout the design process. Public engagement was considerably high and wishes and needs accommodated whenever possible. The building is definitely designed for its local public. The idea of evidence informed design was also implemented and used for issues that caused controversy. An example of such issues is the adoption of open plan offices to relocate clinical staff. Anecdotal and scientific evidence were sought to show that open plan offices, when designed with consideration, can lead to increased exchange of multidisciplinary information, a better working environment considering that all rooms will have access to light and rooms for private and confidential conversations will be available whenever needed. The building should improve considerable the delivery of care whilst also achieving high standards of sustainability and reduced running costs that were simulated up-front. Issues identified that impacted on service provision and running costs (either service design or building configuration) were dealt with in advance so to make the scheme a benchmarking for care delivery at the same time is affordable to the trust.

Final Remarks

This chapter started with the intention of discussing how architecture contributes to enhanced health and wellbeing. The theoretical arguments developed to date show that when designing, it is essential to consider how people experience the environment in situations of stress related to a lack of health or wellbeing. Within this context, designers must assess ambient characteristics such as noise, light, temperature and information embedded within design that can diminish or exacerbate levels of stress and anxiety. It is also evident that social interaction is part of the healing process and that acute care services and facilities must be configured in such a way as to provide for social interaction without excluding individuality and privacy. Finally, it is clear that there is no a solution that fits all in such large and complex buildings, taking into consideration that individual cultural and social backgrounds influence the way people interact with and within their environment.

In practical terms, it is clear that from time-to-time new approaches to design emerge. This chapter placed emphasis on Evidence-Informed Design and how designers can learn from the evidence that is available. The role of the designer is, to a greater extent, to have a deep understanding of design context and to lessons drawn from evidence that can be merged into new ideas. Finally, perhaps the most important lesson that can be learnt from the 3Ts Hospital development is that place-making is central to acute care design. In order for healthcare environments to develop into truthfully healing environments they should be a representation of a popular social expression. The design must focus on people and be designed in collaboration with the people that will benefit from the new environment. There is no space for soulless institutional, factory-like buildings. The lack of health and wellbeing is the

primary reason why acute care settings are designed and as such they should be designed to celebrate life through living.

Acknowledgements

The development of this chapter would not be possible without the support of Professor Duane Passman (3Ts Hospital); Benedict Zucchi and Neil Cadenhead (BDP) and Lindsay McCluskey and Janice McGrory (Salford Royal Fundation Trust) who provided insight and expertise that greatly assisted the research.

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